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Presented by B. L. Robinson, May 14, 1913. Received June 24, 1913.

I. A GENERIC KEY TO THE COMPOSITAE-EUPATORIEAE.

By B. L. Robinson.

It is now more than twenty years since the genera of the *Eupatorium* tribe were keyed by Hoffmann in Engl. & Prantl, Nat. Pflanzenf. iv. Ab. 5 (1890). During this interval several genera have been added to the tribe, some few have been definitely removed from it to other tribes of the *Compositae,* two (*Brachyandra* and *Addisonia*) have been reduced, and certain sections of genera have come to appear worthy of generic rank within the tribe. In consequence the key of Hoffmann, though excellent for its time, is now unsatisfactory and far from complete. The one here offered, though drawn up after some years' study of the group, is put forth rather as a convenient working hypothesis than a finished or monographic product.

In the *Eupatorium* tribe, as elsewhere in the *Compositae,* generic distinctions, though essential for classification, often seem pretty artificial and the more precisely they are stated the greater of necessity becomes the artificial or arbitrary element. A re-examination of the technical characters relied upon by the older authors discloses many exceptions and transitions. On the other hand persistent attempts to secure a more natural classification by relying in larger measure upon habital traits have proved even more disappointing. These, while fairly convincing among plants of a circumscribed area, quickly lose any statable definiteness in dealing with the species of the world. One is in consequence forced to a restatement of the distinctions of pappus, achenes, anther-tips, and involucral-bracts as yielding after all the most practical basis for classification in the group.

In order to employ these more technical features effectively some explanation and definitions are necessary.

The pappus of the *Eupatorium* tribe offers a wide variety, including nearly all forms found in the *Compositae.* Scales, distinct or connate, blunt or bristle-tipped, as well as hairs truly capillary or setiform or awn-like, simple, barbellate, or plumose, rarely clavate or even gland-tipped, all occur within the tribe.

With rare exceptions it has been found possible to distinguish pretty readily between the truly capillary pappus of such genera as *Eupatorium, Mikania,* or *Brickellia* and the also terete but stiffer bristle-formed pappus characteristic of *Agrianthus* and of certain species to be segregated from *Ageratum.* On the other hand it is believed that this bristle-formed pappus can in practically all cases be distinguished from the scale-pappus of the true Ageratums and that it forms a useful basis of separation for some elements long classified with *Ageratum.* More difficult is the sharp distinction of plumose pappus from forms in which the setae are merely barbellate, and while this traditional character seems almost necessary at times it has been employed as sparingly as possible.

A distinction which is more important and which seems never to have been adequately studied even by close students of the *Compositae* is the difference between a very short cup-shaped, saucer-shaped, or coroniform pappus, such as occurs in *Ageratum* § *Coelestina,* and the similar low and often slightly angulate or toothed annulus which often crowns the mature achene in genera like *Alomia,* which lack all true pappus. When seen on fully ripe achenes from which the corolla has fallen away these structures often appear considerably alike, yet even in this late stage differences are usually to be noted. The true pappus, even when very rudimentary, inclines to be cup-shaped and possesses a thin edge. The annulus is a mere low usually thickish cartilagineous or fleshy ring with a blunt edge. If examined in a younger stage, while the corolla is still in place, it will be seen that the true pappus, however rudimentary, is distinctly exterior to the base of the corolla, while the annulus is merely the ringlike base from which the mature corolla disarticulates. This base sometimes enlarges slightly after the corolla falls and has in such species as *Ageratum echioides* or more properly *Alomia echioides* been taken for a true and much reduced pappus. In the peculiar genus *Jaliscoa* the annulus takes on a saucer shape and has frayed quasi ciliolate edge, yet when carefully examined in a young state it can be seen to be a sub-corollar rather than an extra-corollar structure.

To add to the complexity an intra-corollar disk is often present in various rudimentary forms, as for instance in minute fleshy or glandular papillae or in a fleshy ovoid, depressed-globose, or napiform enlargement at the base of the style, capable of some persistence in the mature achene.

The presence or absence of a true (though often much reduced) pappus becomes especially important in distinguishing *Ageratum* § *Coelestina* and *Alomia* and leads, as will be seen elsewhere in this paper, to some readjustment of generic lines. The character is believed to be a good one and to lead to a real distinction between groups which have hitherto been very poorly delimited.

To see clearly what is here meant it is only necessary to compare *Ageratum micropappum,* possessing a true but excessively reduced pappus, with *Ageratum heterolepis, A. echioides, A. microcephalum,* or *A. microcarpum,* all of which so far as observed by the writer have no real pappus but merely a sub-corollar annulus and in consequence are to be referred to *Alomia.*

The involucre in the *Eupatorium* tribe takes on many forms, all more or less intergrading. In *Eupatorium* itself, though the involucre goes through the whole gamut of variation, the number of species is so great that grouping by involucral differences has never appeared to be sharp enough to permit any satisfactory generic segregation of the elements concerned. It is very easy to refer certain marked species to *Osmia* Sch. Bip. and others to *Kyrstenia* Necker, but transitions are innumerable. On the other hand in many of the smaller genera involucral characters furnish distinctions of sectional or even generic value. Three types of involucre may be recognized as follows: 1) in which the chief scales are definite or subdefinite in number (four in *Mikania* and *Kanimia,* five or six in *Stevia)* often surrounded at the base by 1–3 considerably reduced scales i. e. calyculate. 2) the chief scales of indefinite number (though rarely very numerous) and subequal, appearing to be in 1–3 series and often accompanied by a very few much reduced outer ones. This is the common form of involucre in *Ageratum, Kuhnia,* etc. 3) scales of indefinite number (usually numerous) conspicuously unequal and gradually diminishing outward, forming apparently several to many series, though of course in reality spirally arranged. These three types of involucre, while sometimes confluent, are in general pretty readily distinguished.

There are also considerable differences in the texture of the involucral scales and to some extent these may be used, at least as supplementary aids, in distinguishing genera. Thus in *Ageratum,* most Alomias, and several other genera the scales are prevailingly of rather firm texture and pretty definitely 1–3-costate, while in *Brickellia, Hofmeisteria, Podophania, Oaxacania,* etc. the scales are prevailingly thin, flat, and finely striate.

One other character of special classificatory significance in the

Eupatorium tribe needs restatement with greater detail, namely the apical appendage of the anthers. It has long been customary to separate the subtribe *Piquerinae* on the ground that this apical appendage was there absent, yet to this subtribe have been referred several genera, such as *Adenostemma, Gymnocoronis, Hartwrightia, Podophania, Decachaeta, Helogyne,* and *Eupatoriopsis,* which exhibit such an apical appendage in various degrees of development, while in *Eupatorium* proper there are several species in which the appendage is decidedly rudimentary. It will thus be seen that the distinction between the *Piquerinae* and the *Ageratinae* breaks down completely unless it can be supplemented by other characters or restated with proper qualification. Persistent search has failed to discover any correlated differences, so it is necessary to make the most of the anther-appendage.

Examination of the typical *Piquerinae,* such as *Piqueria, Ophryosporus,* etc., shows that the anthers are entirely destitute of apical appendage, nor is the connective upwardly thickened or expanded in a way to cover the cells. If, however, the doubtful genera above mentioned are examined, it becomes evident that the rudimentary appendage assumes several distinguishable forms. In *Decachaeta* and *Podophania* it consists merely of an exceedingly short cushion-like expansion of the dilated summit of the connective. The connective is thus without change of texture broadened out until it partially or entirely covers the apices of the loculi, the whole anther being decidedly blunt or even slightly retuse. It is to be noted that there is here no membranaceous appendage in the stricter sense, and it seems best to retain these genera in the *Piquerinae.*

The next stage in the development of the apical appendage is seen in the three genera *Adenostemma, Gymnocoronis,* and *Hartwrightia.* In these there appears always to be at least a very short and decidedly retuse membranous appendage. This may be a single or simple structure or in *Adenostemma* it is sometimes so deeply divided in the middle that it virtually becomes two small membranous tips crowning and slightly prolonging the two loculi. In other respects these three genera manifest striking similarities, such as the form of the corolla and especially in the uniformly glandular faces of the achenes. Both on account of the seemingly close relationship among themselves and in order to permit a more precise definition of the *Piquerinae* it seems desirable to class these three genera in a new co-ordinate subtribe, the *Adenostemmatinae.*

In *Helogyne* and *Eupatoriopsis* the apical appendage assumes the ovate-oblong form, fairly characteristic of other portions of the *Eupatorium* tribe, and these genera may well be transferred to the *Ageratinae* as has been earlier pointed out. See Proc. Am. Acad. xlii. 27 (1906). With these changes it is believed that the *Piquerinae, Adenostemmatinae,* and *Ageratinae* will be found fairly clear as subtribes. The fourth subtribe of the *Eupatorieae,* characterized by its more numerously ribbed achenes, has been known as the *Adenostylinae* from its (as assumed) typical genus, *Adenostyles* Cass. This genus, however, is one which has always been very dubiously placed with the *Eupatorieae* if classed with them at all. To the writer, after repeated examinations of the genus from various points of view, it seems clear that its real affinity is with the *Senecioneae.* Arguments for this view can be found in many minor details of habit, which taken together become convincing. The elongated style-branches alone would suggest a relationship with the *Eupatorieae,* but even these do not appear really eupatorioid. They tend to an attenuate rather than a clavellate form in the first place, and in the second they are inclined to be recoiled through a much greater arc than is usual among the *Eupatorieae.* Finally the unbranched portion of the style in *Adenostyles* is at maturity commonly exserted, while this would in the *Eupatorium* tribe be highly exceptional. With the removal from the *Eupatorium* tribe of the genus *Adenostyles* the remaining portion of the subtribe hitherto known as the *Adenostylinae* must in accordance with Art. 52 of the International Rules of Botanical Nomenclature be renamed. It may be called the *Kuhniinae.*

The genus *Mallinoa* Coult. Bot. Gaz. xx. 47 (1895) was doubtfully ascribed by its author to the *Inuleae,* its anthers being described as sagittate and being figured (l. c. t. 5, f. 4) as having acute auricles at the base of the anther-cells. Soon after its publication Hoffmann in Engl. & Prantl, Nat. Pflanzenf. Nachtr. 322 (1897) placed *Mallinoa* in the *Eupatorieae,* where there can be no doubt it in reality belongs. For some reason not made clear, Hoffmann, though recognizing the eupatorioid nature of *Mallinoa* placed it next *Trichogonia,* with which it has no close habital resemblance nor striking likeness of involucre or pappus. To the writer *Mallinoa* seems to be merely a species of the genus *Eupatorium,* exceedingly close to the long known *E. bellidifolium* Benth. In foliage, gesture, and inflorescence these plants possess a resemblance amounting almost to identity. *Mallinoa,* however, is readily distinguished (specifically) by its decidedly broader, blunter, and much smoother involucral bracts. In the light of excellent material of both plants secured by Mr, Pringle, the writer finds that the anther-bases in *Mallinoa* are cordate rather than sagittate, the basal auricles being decidely rounded. In *Eupatorium bellidifolium* furthermore the anther-bases are also retuse, the condition being very similar and the difference merely a trifling one of degree and in no sense one of kind. The degree of difference is closely comparable to that shown between fig. 2 and fig. 3 on plate 9 of Bentham's classical "Notes" (Jour. Linn. Soc. xiii.). It will be noticed that Bentham, whose experience and judgment upon these matters have probably never been surpassed, admits the occurrence of anthers of both these types in the *Eupatorium* tribe (l. c. 360). If admitted to the *Eupatorium* tribe at all, *Mallinoa* cannot be kept out of the genus *Eupatorium* as at present delimited.

Regarding the transfer of *Apodocephala* Bak. to the *Vernonieae,* see Proc. Am. Acad. xlii. 32 (1906), and of *Lepidesmia* Klatt to the *Heliantheae,* see Proc. Am. Acad. xlvii. 210 (1911).

Further study, especially of the larger genera, may well reveal profitable generic segregations not as yet clear. This is especially likely to be the case among the numerous and as yet very imperfectly known South American members of the tribe. It is also by no means improbable that when these are more satisfactorily represented in herbaria some new and more convincingly natural re-adjustment of generic lines will become possible. Furthermore, it is to be remembered by users of the following key that disconcerting exceptions and anomalies occur here as elsewhere among the *Compositae,* as for instance four-, six-, or even seven-angled achenes among the normally 5-angled ones in the *Ageratinae,* or occasionally calvous achenes in certain heads of the normally pappus-bearing genera *Trichogonia* and *Ageratum.*

Subtr. I. Piquerinae. Antherae apice omnino exappendiculatae vel a connectivo sursum leviter incrassato et supra loculos plus minusve lateraliter expanso truncato vel retuso terminatae. Achaenia non glandulari-papillifera.

a. Pappus nullus vel rarissime brevissime obsoleteque setosus. . 1. *Piqueria*
a. Pappus setosus *b.*
  b. Pappi setae laeves vel modice scabratae *c.*
    c. Pappi setae saepissime 10 sursum clavellatae. Folia pleraque alterna 3-lobata vel non lobata. Capitula parva numerosa subsessilia paniculata. . . . . 2. *Decachaeta.*
    c. Pappi setae tenues non clavellatae. Folia opposita dissecta. Capitula axillaria longe pedunculata. . . . . 3. *Podophania.*
  b. Pappi setae plumosae. . . . . 4. *Ophryosporus.*

a. Pappus squamosus *d*.
d. Pappi squamulae breves fimbriatae. Ind. Occ. . . . . 5. *Phania*.
d. Pappi squamulae longae integrae apice in aristam attenuatae. Mex. . . . . 6. *Ageratella*.

Subtr. II. **Adenostemmatinae**, subtr. nov. Antherae apice breviter appendiculatae, appendice membranacea aut simplici et retusa aut bifida et apices loculorum coronante. Corollae tubus brevis et fauces infundibulares. Achaenia obovoidea glandulari-papillosa.

a. Pappus e setis brevibus 3–5 clavatis ab annulo patentim ascendentibus compositus . . . . 7. *Adenostemma*.
a. Pappus nullus vel brevissime obsoleteque setosis, setulis numquam clavatis *b*.
b. Receptaculum nudum. Folia opposita dentata. Mex., Am. Aust. 8. *Gymnocoronis*.
b. Receptaculum margine paleiferum. Folia alterna integra. Fla. 9. *Hartwrightia*.

Subtr. III. AGERATINAE. Antherae apice cum appendice membranacea ovata vel oblonga integra vel retusa instructae. Achaenia normaliter 5(rarissime 4–6)-angulata prismatica vel subprismatica rariter compressa eglandularia vel rariter glandulari-atomifera.

a. Pappus e squamis distinctis vel basi connatis aut ex aristis deorsum squamiforme expansis aut ex aristis et squamellis aut e corona dentata vel fimbriata vel integra compositus aut omnino deficiens *b*.
b. Involucri squamae 5–6 uniseriales subaequales cum vel absque 1–3 squamulis extimis multo brevioribus . . . . 10. *Stevia*.
b. Involucri squamae ∞ saepius numerosa 2–∞-seriatae *c*.
c. Pappus evolutus e squamis aut distinctis tenuibus vel rare indurescentibus aut in cupulam coroniformem tenuem scariosam dentatam vel integram connatis compositus rarissime (apud *Agerati* spp.) obsoletus *d*.
d. Involucri squamae valde inaequales ∞-seriatim imbricatae *e*.
e. Pappus coronam crateriformem margine laciniatam formans. Folia bipinnatifida. Bras. . . . . 11. *Lomatozona*.
e. Pappus e squamulis brevibus obovatis vel oblongis obtusis compositus *f*.
f. Receptaculum pilosiusculum. Pappi paleae apicem versus denticulatae. Folia penninervia. Bras. . . . . 12. *Carelia*.
f. Receptaculum paleaceum. Pappi paleae breviter fimbriatae. Folia 3-nervia. Mex. 13. *Aschenbornia*.
e. Pappus ex aristis cum squamulis alternantibus aut ex aristis basi squamiforme dilatatis compositus *g*.
g. Folia sessilia linearia subintegra. Herba annua. Calif. infer. . . . . 14. *Malperia*.
g. Folia longiuscule petiolata dentata vel lobata vel dissecta. Frutices vel suffrutices . . . . 15. *Hofmeisteria*.
d. Involucri squamae subaequales 2–3-seriales cum vel absque squamulis 1–3 extimis multo brevioribus *h*.
h. Pappi squamae distincte indurescentes. Folia verticillata. Am. Bor. atlant. . . . . 16. *Sclerolepis*,

h. Pappus tenuis non indurescens. Folia opposita vel alterna *i.*

i. Corollae tubus bene distinctus subfiliformis in fauces discrepitante ampliatas campanulatas subito transiens. Folia subcoriacea. Suffrutices. Mex...17. *Oxylobus.*

i. Corollae tubus saepissime brevis, faucibus vix distinctis vel solum modice ampliatis. Folia membranacea............................18. *Ageratum.*

c. Pappus verus nullus, achaeniis tamen cum annulo sub corolla numquam extra corollam orienti coronatis *j.*

j. Achaenia 4–5-angulata. Involucrum non foliaceum *k.*

k. Achaenia prismatica *l.*

l. Herbae vel frutices non repentes...............19. *Alomia.*

l. Herba repens. Columbia................20. *Tuberostyles.*

l. Frutex. Caulis fistulosus et maturitate clathratus. Mex. 21. *Jaliscoa.*

k. Achaenia compressiuscula. Frutex, foliis alternis suborbicularibus sinuato-lobulatis. Mex...............22. *Oaxacania.*

j. Achaenia 6-angulata. Involucri squamae exteriores subfoliaceae. Bras...23. *Planaltoa.*

a. Pappus setosus, setis capillaribus vel firmiusculis, liberis vel basi in annulum coalitis *m.*

m. Pappi setae plumosae *n.*

n. Achaenia compressa. Pappi setae brevissimae. Bras. 24. *Eupatoriopsis.*

n. Achaenia prismatica *o.*

o. Pappi setae firmiusculae saepissime breves non rite capillares *p.*

p. Capitula sessilia. Folia squamiformia imbricata 25. *Agrianthus.*

p. Capitula pedicellata. Folia cum lamina normali 27. *Trichogonia?*[1]

o. Pappi setae capillares plumosae *q.*

q. Corollae fauces subcampanulatae a tubo proprio differentiatae 27. *Trichogonia.*

q. Corolla graciliter tubulata sine faucibus distinctis *r.*

r. Folia alterna. Frutices xerophyticae. Am. Aust. occ. 28. *Helogyne.*

r. Folia opposita. Herba. Am. Bor. aust.-occ. et Mex. 29. *Carminatia.*

m. Pappi setae capillares simplices laeves vel modice scabratae *s.*

s. Achaenia valde compressa. Pappi setae 2. Mex. 30. *Schaetzellia.*

s. Achaenia prismatica. Pappi setae 5–∞ *t.*

t. Pappi setae longitudine valde conspicueque inaequales. Am. Aust. 31. *Dissothrix.*

t. Pappus uniformis vel subaequalis *u.*

u. Pappi setae brevissimae paucae longitudine crassitiem achaenii vix aequantes...........................32. *Trichocoronis.*

u. Pappi setae achaenii longitudinem subaequantes *v.*

v. Pappi setae caducae *w.*

w. Involucri squamae valde inaequales ∞-seriatim imbricatae. Folia opposita. Mex..................33. *Piptothrix.*

w. Involucri squamae subaequilongae ca. 2–3-seriatim laxe imbricatae. Folia alterna. Bras.......34. *Leptoclinium*

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[1] Hic expeterentur species quaedam adhuc dubiae ex *Agerato* ob pappo setiformi expulsae et ad *Trichogoniam* valde approximantes.

v. Pappus persistens *x.*

x. Pappi setae basi in annulum crassiusculum coalitae. Folia coriacea. Bras.............35. *Symphyopappus.*

x. Pappi setae basi liberae vel levissime inconspicueque coalitae. Folia saepissime membranacea *y.*

y. Involucri squamae ut flosculi ∞ *z.*

z. Pappi setae subdefinitae saepissime 5. 36. *Fleischmannia.*

z. Pappi setae ∞ numerosae. Receptaculum nudum vel obscure setiferum................37. *Eupatorium.*

z. Pappi setae ∞ numerosae. Receptaculum paleiferum. Folia magna. Mex..........38. *Eupatoriastrum.*

y. Involucri squamae definitae 4. Flosculi etiam 4. Herbae vel frutices saepissime volubiles..39. *Mikania.*

Subtr. IV. **Kuhniinae,** nom. nov. Antherae apice cum appendice membranacea ovata vel oblonga munitae. Achaenia 10–20 (rariter 6–9)-costata.— *Adenostylinae* auct. excl. *Adenostyle* genere ipsissimo nominiferente.

a. Involucri squamae definitae 4. Flosculi etiam 4...........40. *Kanimia.*

a. Involucri squamae ∞ saepissime numerosae *b.*

b. Pappus setosus *c.*

c. Receptaculum nudum *d.*

d. Achaenia compressa. Foliorum dentes saepissime setiferae. Mex. 41. *Barroetea.*

d. Achaenia prismatica vel teretia *e.*

e. Involucri squamae valde inaequales pluriseriatim imbricatae *f.*

f. Involucri squamae tenues striatae vix herbaceae. Pappi setae uniseriatae laeves vel barbulatae. Folia opposita vel alterna 42. *Brickellia.*

f. Involucri squamae herbaceae vel coloratae vel scariosae non conspicue striatae. Pappi setae uniseriatae saepissime plumosae rariter barbulatae. Herbae perennes, caule saepius simplici basi tuberoso........................43. *Liatris.*

f. Involucri squamae herbaceae. Pappi setae 2–3-seriatae, exterioribus brevioribus. Frutex foliis alternis obovatis. Fla. 44. *Garbera.*

e. Involucri squamae subaequales 2–3-seriatae. Folia saepissime alterna *g.*

g. Pappi setae capillares conspicue plumosae....45. *Kuhnia.*

g. Pappi setae firmiusculae vix barbulatae.......46. *Trilisa.*

c. Receptaculum paleiferum. Folia alterna........47. *Carphephorus.*

b. Pappus ex aristis basi squamiforme dilatatis compositus. Folia opposita. Am. Bor. aust.-occ. et Mex......................48. *Carphochaete.*